OPTIMATION

Division of

JULIE RESEARCH LABORATORIES, INC.
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INSTRUCTION MANUAL

MODELS RCD-10 & RCD-10B

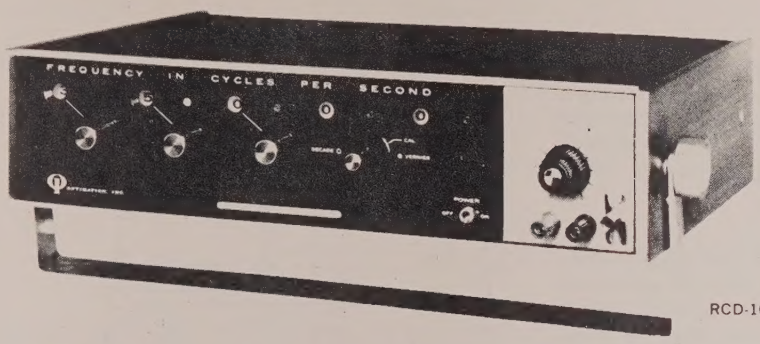
PRECISION RC OSCILLATOR

4/80

OPTIMATION

RCD - 10

PRECISION OSCILLATOR



RCD-10

FEATURES

* **PURE WAVEFORM 99.98%** — eliminates waveform error under any linear load conditions.

* **STABLE AMPLITUDE 20ppm** — for at least 1-2 minutes, "stays put" within 100ppm/hour for the most exacting laboratory calibration requirements.

* **ULTRA WIDE FREQUENCY RANGE 0.1 Hz to 100 kHz** — with direct in-line digit setability insures accurate and repeatable frequency.

* **FLAT FREQUENCY RESPONSE ±0.05 db** — eliminates the need to monitor output voltage as the frequency is changed.

SPECIFICATIONS

FREQUENCY

RANGE, Standard	0.1 to 99,900 Hz
ACCURACY, 0.1 to 99,900 Hz	1%
INSTABILITY, 1 hour, constant temperature	0.01%
Temperature coefficient	0.02%/°C.
RESPONSE, 10 Hz to 10 kHz (±0.3 db at 0.1 Hz and 100 kHz)	±0.05 db
EXTERNAL FREQUENCY SYNC, 10V RMS	Locks over a ±0.5% frequency range

PURITY

DISTORTION, Harmonic, 90 to 50,000 Hz (0.03% at 20 Hz and 100 kHz)	0.02%
HUM AND NOISE, (% of output)	0.005%
MODULATION, near line frequency	0.05%

OUTPUT

VOLTAGE, Open circuit, maximum	5V RMS
AMPLITUDE INSTABILITY, Short term 1-2 minutes	20 ppm
1 hour, constant temperature	100 ppm
Cycle to cycle variations	0.02%
With 10% line voltage variation	50 ppm
AMPLITUDE CONTROL	11 position switch with interpolating potentiometer
IMPEDANCE	50-200 ohms

POWER REQUIREMENTS, 105-125 VAC/210-250 VAC, 50 to 400 Hz ..... 30 VA

SIZE ..... Bench Mount — 3½H x 15W x 11D — Rack Mount — 3½H x 19W x 11D

See typical performance data and optional features on the reverse side.

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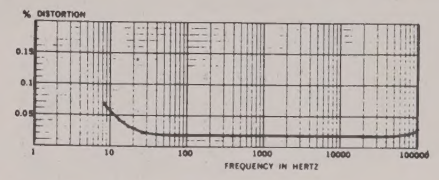
211 West 61st., New York, N.Y. 10023 (212) 245-2727 TWX 7105815138

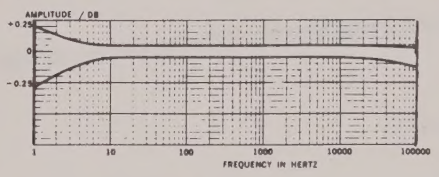
Specifications

RCD-10

DISTORTION as a function of frequency is shown for a typical RCD-10. The pure and stable output permits precise testing of instruments, components, or systems requiring signals from 0.1 Hz, This extremely low distortion is achieved by Optimation's new unique solid state circuitry.



FREQUENCY RESPONSE is plotted with the zero reference at 1,000 Hz. An internal amplitude adjustment trimmer is provided for each decade frequency range to insure flat frequency response from range to range. Frequency switching transients are minimized by use of a special diode clipping circuit that limits the magnitude of switching overshoot, thus speeding up recovery time.



APPLICATIONS include Precision Meter Calibration, Ground Support Equipment, Production Line, Quality Assurance, Incoming Inspection, Gyro Testing, Vibration Testing, Subsonic, Ultrasonic, and Video Testing, and as a general purpose laboratory instrument wherever wide, stable, and accurate frequency outputs of stable amplitude with low distortion are required. Versatility of the RCD-10 is enhanced by options listed below.

ADDITIONAL FEATURES

FLOATING or GROUNDED OPERATION is possible by means of an insulated inner chassis. A front panel terminal with attached shorting link facilitates grounding the low side output.

VERNIER FREQUENCY CONTROL is provided in addition to the three in-line frequency digit selectors. This provides a means to set frequency to values in between steps of the least significant digit. A calibrate position is provided on the vernier for best overall frequency accuracy.

OPTIONAL FEATURES

	OPTION
INFINITE RESOLUTION FREQUENCY VERNIER potentiometer provides high resolution frequency setability—maximum Δf, 0.25% of frequency set.	D
HIGH RESOLUTION AMPLITUDE CONTROL consisting of a three stage vernier potentiometer plus a 10 position coarse switch provides resolution of <5 ppm full scale.	H

TO ORDER OPTIONAL FEATURES, specify features desired by respective letter.

WARRANTY

Optimation instruments are manufactured and tested under an exacting quality control program. Conservatively rated, premium components are used in our instruments to insure long reliable operation within specifications. We warrant each instrument to be free from defects in material and workmanship. We will adjust, service and/or replace any defective parts (tubes excepted), in instruments returned to us, for 1 year after delivery to the original buyer.

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SECTION I

GENERAL INFORMATION

1-1. SCOPE.

1-2. This publication covers the Standard Optimation, Inc. Model RCD-10 and RCD-10B Precision Sine Wave Oscillator. Optional differences which may also be contained in the Oscillator are noted on the difference data sheet(s) at the front of this manual.

1-3. GENERAL DESCRIPTION.

1-4. RCD-10 DESCRIPTION. The Model RCD-10 is a Precision Sine Wave Oscillator which is designed to meet the exacting requirements of an AC calibration source. The wide frequency range, stable amplitude and pure waveform makes it ideally suited for use wherever a precision AC signal source is required, such as meter calibration, distortion measurements, incoming inspection, ground support equipment and other general laboratory testing applications. Output frequency of the RCD-10 is digitally dialed-in over the frequency range of 10 to 99,900 Hertz. The accuracy of the setting is better than 1.0% with a resolution of three digits over the frequency range of 10 to 99,900 Hertz. An external frequency sync feature allows the Oscillator to be frequency locked to an external signal. A floating decimal point is provided so that the front panel frequency setting is always read directly in Hertz and does not require interpolation by the operator. A step and vernier attenuator is provided to precisely set the output amplitude over the range of 0 to 5.0 volts rms, open circuit.

1-5. RCD-10B DESCRIPTION. When optional feature B, Accurate Frequency, is included in the standard Model RCD-10 an additional frequency selector switch is provided to improve the accuracy of the frequency setting to better than 0.1% over the frequency range of 10 to 9,999 Hertz. Setting accuracy decreases to about 3.0% at 0.1 Hertz and 0.3% at 90,000 Hertz.

1-6. Some of the significant operating features of the Models RCD-10 and RCD-10B are:

1. Wide frequency range of 10 to 99,900 Hertz. (RCD-10) or 0.1 to 99,900 Hertz (RCD-10B)

2. Accurate output frequency of ±1.0% (RCD-10) or ±0.1% (RCD-10B).

3. Low distortion of less than 0.02% from 90 Hertz to 50 kilohertz.

4. Flat frequency response of better than ±0.05db from 10 Hertz to 10 kilohertz.

5. Output amplitude of 0 to 5.0 volts rms, open circuit.

1-7. SPECIFICATIONS.

1-8. The Model RCD-10 is designed for continuous operation in a normal laboratory environment over the ambient temperature range of 0°C to 55°C. Within this range, the Oscillator will operate with the performance and accuracy specified in table 1-1. Warm up time for the given accuracies is 1½ hours.

1-9. OPTIONAL FEATURES.

1-10. The Model RCD-10 or RCD-10B may contain one or more of the optional features which are described below. A serial number label affixed to the rear panel identifies the option(s), if any, which are contained in the Oscillator. For example, the Model RCD-10DS includes options D and S. Operational differences in the Oscillator which are affected by these optional features are described by difference data sheets.

1. Option C, STABLE FREQUENCY. Frequency instability is held to less than 10 ppm at a constant temperature. Temperature coefficient is less than 30 ppm/°C from 10 to 9,999 Hertz. Only available on the RCD-10B.

2. Option D, HIGH RESOLUTION FREQUENCY VERNIER. Optional frequency vernier potentiometer provides high resolution frequency setability. Maximum change is 0.25% of the setting. Only available on the RCD-10B.

3. Option F, ZERO OUTPUT IMPEDANCE. Up to 50 milliwatts of output power is provided by a direct coupled solid state amplifier. Short circuit protection is included.

4. Option H, HIGH RESOLUTION AMPLITUDE CONTROL. Consists of a three-stage vernier amplitude potentiometer plus an 11 position coarse step attenuator to provide a resolution of less than 3 ppm, full scale. Short term amplitude stability is better than 20 ppm with option H.

5. Option S, SQUARE WAVE OUTPUT. In addition to the sine wave output, option S provides a 0 to 27 volts P-P square wave output (switch selectable). Rise time is better than 0.1% of the period or 100 nanoseconds.

6. Option W, 1 MHz FREQUENCY RANGE. Provides an extended output frequency range from 0.1 Hertz to 1 MHz. Accuracy of the setting is ±1.0% with 3 digit setability. Option W is not available with option D.

1-11. PREPARATION FOR RESHIPMENT.

1-12. Electronic calibration equipment and test instruments must be packed with special care. The shipping carton in which the Oscillator was originally packed is designed to provide maximum protection from adverse environments and from the shock and vibration incurred during shipment. It should be preserved and utilized for reshipment or subsequent storage whenever possible. When preparing the Oscillator for reshipment, ensure that the container is well sealed with strong tape or metal bands.

TABLE 1-1. SPECIFICATIONS.

FREQUENCY (RCD-10)

Range	10 Hz to 99900 Hz in four decade ranges.
Resolution	3 most significant digits and a vernier control.
Accuracy	±1.0% of setting from 10 to 99900 Hertz.
Stability	±0.01%/hour at a constant temperature.
Temperature Coefficient	0.02%/°C, maximum.
Response	±0.05db from 10 Hertz to 20 kilohertz. ±0.15db at 100 kilohertz.
External Frequency Sync	Locks Oscillator frequency over a ±0.5% range with a 10 volt rms input signal.

FREQUENCY (RCD-10B)

Range	0.1 Hz to 99990 Hz in four decade ranges.
Resolution	4 most significant digits and a vernier control.
Accuracy	±0.1% of setting from 10 to 9999 Hertz. ±3.0% at 0.1 Hertz and 0.3% at 90 kilohertz.
Stability	±0.01%/hour at a constant temperature.
Temperature Coefficient	0.02%/°C maximum.
Response	Same as RCD-10.
External Frequency Sync	Same as RCD-10.

TABLE 1-1. SPECIFICATIONS.

PURITY

Harmonic Distortion	Less than 0.02% from 90 to 50,000 Hertz. Less than 0.03% at 20 Hertz and 100 kilohertz.
Hum and Noise	Less than 0.005% of output.
Modulation	Less than 0.05% at or near the AC line frequency.

OUTPUT

Voltage	0 to 5.0 volts rms, maximum open circuit.
Impedance	50 to 200 ohms.
Coupling	Direct with a DC balance adjustment.
Configuration	Isolated from ground (floating) or grounded.

AMPLITUDE

Instability:	
Short Term, 1-2 minutes	20ppm maximum.
Cycle to Cycle	0.02% maximum.
With 10% Line Variation	50ppm maximum.
Attenuation	11 position step attenuator with interpolating vernier potentiometer.

POWER REQUIREMENTS

Line Voltage	115 volts AC, ±10%, or 230 volts AC, ±10%, switch selectable. 1Ø.
Line Frequency	50 to 400 Hertz.
Power Consumption	30VA.

TABLE 1-1. SPECIFICATIONS.

MECHANICAL REQUIREMENTS

Dimensions:	
Rack Mounting	3½"H x 19"W x 11"D.
Bench Mounting	3½"H x 15"W x 11"D.

SECTION II

INSTALLATION

2-1. UNPACKING AND HANDLING.

2-2. The Oscillator is shipped in a single packing container. All of the accessories which are supplied are packed in the same container. Handle the instrument carefully when removing it from the shipping container, using caution not to damage any of the front or rear panel operating controls.

2-3. POWER REQUIREMENTS.

2-4. The Oscillator is designed to operate from 115 volts, ±10%, or 230 volts, ±10%, single-phase AC, at a line frequency of 50 to 400 Hertz. The AC LINE selector switch located on the rear panel converts the Oscillator from one operating voltage to the other. To convert the instrument from 115 volts to 230 volts, move the slide switch with the tip of a screwdriver to the 230 volts position and change fuse F1 to 0.15 amps, slo-blo.

2-5. INITIAL INSPECTION.

2-6. VISUAL INSPECTION. Inspect the Oscillator after unpacking for damage that may have occurred during transit. Check that there are no loose or broken knobs, bent or broken panel connectors, and dents or scratches on the cabinet surfaces. Specifically, the instrument should be visually inspected for the following items before placing it into operation:

1. Check that the front panel frequency selector switches can be rotated freely and without binding through the 10 detent positions, 0 through 9.

2. Check that the rear panel AC LINE selector switch is set to 115 volts unless the Oscillator is to be operated from a 230 volt AC line source.

3. Remove the cover by removing the two rear panel pan head screws and sliding the chassis out of the cover.

4. Check that all socket mounted components, such as transistors and potentiometers, are firmly seated into the sockets.

5. Check that the lamps are not damaged or broken and are properly seated in the sockets.

6. Check for any loose or damaged components.

7. Replace the cover and 2 pan head screws.

NOTE

If the Oscillator was damaged during shipment it must be reported immediately to the responsible carrier. A complete report of the damage must be submitted to the carrier's claim agent with a copy forwarded to Optimation, Inc. Unless this damage claim is properly filed, Optimation, Inc. can not be held responsible for any subsequent repair or replacement charges.

2-7. INSTALLATION REQUIREMENTS.

2-8. GENERAL. The Oscillator does not require any special installation procedures or cooling requirements. Two different mounting cabinets are available for the Oscillator and are described below.

2-9. CABINET MOUNTING. The standard Oscillator is supplied in a cabinet which is suitable for either bench or portable use. A convenient combination handle and tilt stand can be used to carry the instrument and then when locked in the lower detent position provides an easy viewing angle of the front panel for bench operation. Four plastic feet are mounted on the bottom which protects the cover from scratches.

2-10. RACK MOUNTING. When optional feature R is supplied, the Oscillator is mounted in a rack mounting cabinet. It can be installed in any EIA standard 19 inch wide cabinet that has 3½ inches of panel mounting space available with the four rack mounting screws supplied. Care must be taken to allow a minimum of 6 inches of clear space behind the Oscillator and at least 3 inches of clear space at both sides to permit the proper circulation of air. The instrument is cooled by normal convection and does not require any additional cooling when operated within the operating temperature range.

2-11. CABLE ASSEMBLIES.

2-12. AC POWER CABLE. A separate 3-conductor electrical power cord is supplied with the Oscillator which connects to the rear panel ACLINE receptacle. For the protection of operating personnel the front panel and cabinet are connected to the ground pin of the AC LINE receptacle. If the instrument is to be connected to a 2 pin non-polarized electrical outlet, a 2 prong adapter plug must be used with the pigtail wire of the adapter connected to an adequate electrical ground.

2-13. OUTPUT LEADS. The output terminals for the Oscillator are standard multiple use binding posts which will accept a GR type of banana plug, spade connectors or tinned leads. Output terminals are provided on both the front and rear panels. The internal impedance of the Oscillator is low and at most output voltage levels the length and type of leads used is not critical. However, if the instrument is to be used as a source of real low signal levels it is recommended that the output leads be shielded.

2-14. INITIAL OPERATION AND CALIBRATION.

2-15. INITIAL TURN ON. Connect the AC line cord between the rear panel AC LINE receptacle and a suitable power source (see paragraph 2-3). Set the POWER switch to ON and check that each of the FREQUENCY IN CYCLES PER SECOND digit windows light and that one of the decimal points light. Rotate the DECADE switch through each detent position and check that a decimal point lights for each setting. The Oscillator is now ready for operation.

2-16. INITIAL CALIBRATION. All internal adjustments have been made at the factory and the Oscillator has been calibrated with laboratory standards which are traceable to the National Bureau of Standards. Calibration data can be obtained directly from Optimation, Inc. When requesting data be sure to include the serial number and complete model number of the Oscillator with your request.

SECTION III

OPERATION

3-1. GENERAL.

3-2. The Model RCD-10 is an extremely accurate AC source which can be used for a wide range of general applications. To make effective use of the instrument, the operation of all controls and the performance capabilities must be known. This section of the manual describes the operation of these controls and connectors, and contains general operating information.

3-3. OPTIONAL FEATURES. Optional features which may affect the operation of standard controls and connectors may also be included in the Oscillator. The difference data sheets at the front of this manual describes these features if contained in the instrument.

3-4. OPERATING TEMPERATURE.

3-5. The Model RCD-10 can be operated where the ambient air temperature is between 0°C and 50°C. It can be stored in ambient air temperatures that are between -25°C and 75°. After storage in ambient air temperatures that are beyond the operating limits, allow the chassis to reach the operating limits before applying power to the instrument to prevent moisture condensation.

3-6. OPERATING CONTROLS AND CONNECTORS.

3-7. GENERAL. A brief description of the function and operation of each operating control and connector for the RCD-10 and RCD-10B follows. Detailed instructions are given in paragraphs 3-10 and 3-14.

3-8. FRONT PANEL.

1. FREQUENCY IN CYCLES PER SECOND.- Selector switches that set the three most significant digits (left-hand) of the output frequency. The digit indicators display the selected frequency

with the two least significant digits (right-hand) fixed at zero so that the frequency setting is always read directly in Hertz. The four most significant digits of frequency can be selected on the RCD-10B with only the least significant digit fixed at zero.

2. DECADE.- Selects the decade frequency range and positions the floating decimal point. Four decade ranges are provided.

3. VERNIER.- Adjusts the output frequency over a vernier range of approximately ±1.5% (0.15% on RCD-10B) of the setting. Output frequency is calibrated to the front panel setting when the VERNIER control is set to the CAL position.

4. POWER.- Controls power to the Oscillator. Frequency digit indicators and one decimal lamp will light when set to ON.

5. OUTPUT LEVEL.- Step and vernier attenuators. The STEP attenuator is calibrated in approximate 10% steps. The VERNIER attenuator provides continuous attenuation of the output amplitude between the fixed steps. Resolution is approximately 0.1% of full scale.

6. GND.- Chassis ground terminal for grounding the low side of the floating output.

3-9. REAR PANEL.

1. ØA.- Floating output terminals for the Oscillator output signal wired in parallel with the front panel output terminals. Not available when option W is included in the instrument.

2. OSC DC BAL.- Screwdriver adjustment for setting the DC component of the output signal to zero volt.

3. DC BAL TEST.- Test points for setting the OSC DC BAL adjustment.

4. SYNC INPUT.- Input connector for external frequency synchronizing signal. Synchronization range is ±0.5% maximum.

NOTE

When synchronizing the output frequency to an external signal the front panel frequency selector switches must be set to within ±0.5% of the external frequency.

5. 10Hz (RCD-10B only).- Calibrates the output frequency on the 10Hz to 100Hz decade range.

6. 100Hz (RCD-10B only).- Calibrates the output frequency on the 100Hz to 1kHz decade range.

7. 1000Hz (RCD-10B only).- Calibrates the output frequency on the 1kHz to 10kHz decade range.

8. 10000Hz (RCD-10B only).- Calibrates the output frequency on the 10kHz to 100kHz decade range.

3-10. PRELIMINARY OPERATION.

3-11. GENERAL. The Model RCD-10 does not require any special preliminary operating procedures. The following paragraphs are only intended as a guide and operator familiarization with the instruments operation.

3-12. INITIAL TURN ON. The following steps outline the general procedure when initially applying power.

1. Check that the rear panel AC LINE selector switch is set to the correct position (115 or 230 volts) for the power source that is to be used.

2. Set the OUTPUT LEVEL controls to minimum (fully counterclockwise).

3. Set the POWER switch to ON.

4. The Model RCD-10 is now ready for operation. To meet the specifications listed in table 1-1 a 1½ hour warm up period must be allowed after the Oscillator is initially turned on. If operation is attempted without sufficient warm up the output amplitude and frequency may slowly drift and exceed the given specifications.

3-13. OPERATION. The steps below demonstrate the correct procedure to be followed when setting the front panel controls for typical applications. Paragraph 3-14 gives detailed operating procedures for each control and connector.

1. Set the STEP and VERNIER OUTPUT LEVEL controls to minimum (fully counterclockwise).

2. Set the frequency and DECADE range switches to the desired output frequency. Frequency is read directly in Hertz with the decimal point automatically positioned.

NOTE

The most significant figure of the desired frequency should be set in the left-hand frequency digit for the greatest accuracy and resolution of setting.

3. Set the VERNIER frequency control to the CAL position.

4. Connect the output terminals for a grounded or floating output configuration. Refer to paragraph 3-25.

5. Adjust the STEP and VERNIER OUTPUT LEVEL controls for the desired output amplitude.

3-14. GENERAL OPERATING INFORMATION.

3-15. DC BALANCE ADJUSTMENT. A DC BAL screwdriver adjustment is provided on the rear panel to set any DC offset level that may be present on the output signal to essentially zero volt. This adjustment is critical only when the load being driven by the RCD-10 is sensitive to DC offset levels which are on the order of ±10 millivolts or greater. Because of the inherently stable characteristics of the Oscillator it is not normally necessary to adjust the DC BALance between calibration cycles. Refer to the calibration procedures for setting the DC balance.

3-16. OUTPUT FREQUENCY. The output frequency of the RCD-10 is set accurately using front panel operating controls which eliminates the need for external frequency monitoring instruments for most applications. The three most significant digits (four digits on RCD-10B) of frequency are set by the frequency selector switches and the frequency range is set by the DECADE switch. The VERNIER control varies the output frequency over a narrow high resolution vernier range for setting the Oscillator with an accuracy greater than can be obtained with the frequency selector switches. The following paragraphs describe the operation of these controls and the accuracy for both the RCD-10 and RCD-10B.

3-17. RCD-10 FREQUENCY ACCURACY. The accuracy of the output frequency is within ±1.0% over the frequency range of 10 to 99,900 Hertz when the VERNIER control is set to the CAL position. Frequency response is virtually flat, ±0.05db over the range of 10 Hertz to 10 kilohertz. For applications that require an accuracy which is greater than ±1.0% the VERNIER control can be used to set the exact frequency desired while monitoring the output with an external frequency counter.

3-18. RCD-10B FREQUENCY ACCURACY. When option B, Accurate Frequency, is included in the RCD-10 frequency setting accuracy is within ±0.1% over the frequency range of 10 to 9,999 Hertz when the VERNIER control is set to the CAL position. Accuracy of the setting decreases to about ±3.0% at 0.1 Hertz and 0.3% at 90,000 Hertz. Frequency response is virtually flat, ±0.05db over the range of 10 Hertz to 10 kilohertz.

3-19. DECADE FREQUENCY RANGES. Four decade frequency ranges are provided that cover the output frequency range of 10 Hertz (0.1 Hertz on RCD-10B) to 100 kilohertz. The DECADE range switch selects one of the ranges and lights the corresponding decimal lamp. To achieve the greatest accuracy and resolution, the lowest decade range where the desired output frequency setting can be obtained should always be used. Table 3-1 and 3-2 show the range of frequency settings for each decade range.

TABLE 3-1. RCD-10 DECADE FREQUENCY RANGES.

FREQUENCY RANGES	SETTING RANGE
10.0 Hz	10.0 to 99.000
100 Hz	100.00 to 999.00
1000 Hz	1000.0 to 9990.0
10000 Hz	10000. to 99900.

TABLE 3-2. RCD-10B DECADE FREQUENCY RANGES.

FREQUENCY RANGES	SETTING RANGE
100 Hz	00.010 to 99.990
1000 Hz	100.00 to 999.90
10000 Hz	1000.0 to 9999.0
100000 Hz	10000. to 99990.

3-20. RCD-10 DISCRETE FREQUENCY SETTING. The discrete frequency setting is made with the front panel selector switches which select the three most significant digits of output frequency. This provides three digit resolution over the frequency range of 10 to 99,900 Hertz. The two least significant digits are fixed at zero so that the displayed front panel setting is always read directly in Hertz and does not require any additional interpolation by the operator.

3-21. RCD-10B DISCRETE FREQUENCY SETTING. With option B (designated RCD-10B) a fourth frequency selector switch is provided. This permits the four most significant digits to be set which increases the resolution to 0.1% over the range of 10 to 9,999 Hertz. The least significant digit only is fixed at zero of the RCD-10B. The same procedure for setting the output frequency described above should be followed always setting the most significant digit on the left-hand selector switch.

Selection of frequencies over 10 Hertz should always be made with the most significant figure of the desired frequency set in the extreme left-hand digit. For frequencies which are between 0.1 and 9.9 Hertz, the setting should be made as far to the left as possible. Setting the frequency in this manner will provide the maximum amplitude stability, lowest signal distortion and best resolution. For example, 10 Hertz could be set in the following three ways:

1. 10.000
2. 010.00
3. 0010.0

Example 1 is the correct method and has a resolution of 0.1 Hertz, while in example 2 the resolution is 1.0 Hertz and example 3 it is 10 Hertz.

3-22. VERNIER FREQUENCY CONTROL. The VERNIER frequency control adjusts the output frequency over a narrow range of approximately ±1.5% (±0.15% for RCD-10B) from the front panel setting. For most applications the VERNIER control should be left at the CAL setting. At this setting the output frequency is calibrated to the front panel setting and is optimized for the best tracking over the four decade frequency ranges. For applications where an accuracy of better than ±1.0% (±0.1% on RCD-10B) is required, the VERNIER control can be used to set the output frequency with a resolution of approximately 0.006% of setting. To set the VERNIER control with an external counter proceed as follows:

1. Connect a Digital Frequency Counter to the front panel output terminals.

2. Set the frequency and DECADE switches to the desired frequency setting.

3. While monitoring the output frequency on the counter, set the VERNIER control for the exact frequency desired.

NOTE

Due to the poor input impedance linearity of most digital frequency counters the counter must be disconnected after the VERNIER frequency adjustment is made or the RCD-10 output may be excessively distorted.

3-23. FREQUENCY SYNC INPUT. A rear panel input connector is provided for synchronizing the Oscillator with an external signal. The

amplitude of the external signal should be nominally 10 volts rms for optimum performance. Input impedance is relatively high, 120 kilohms. The Oscillator will frequency lock to the external signal over a wide range of ±0.5% of the front panel setting. However, the output amplitude of the RCD-10 is affected by approximately the same percentage as the frequency variation. Thus, it is recommended that an external signal with a frequency stability of 0.1% or better should be used. When syncing the RCD-10 (without option B) to the external signal the frequency must be accurately set (i.e., to within ±0.5%) using the VERNIER frequency control and an external counter (see paragraph 3-22). The RCD-10B can be set to within ±0.1% with the front panel controls and does not require external frequency monitoring.

NOTE

An external synchronization signal which has less than 0.02% of distortion should be used or the output distortion of the RCD-10 will be increased proportionately.

3-24. OUTPUT ATTENUATION. The nominal open circuit output amplitude of the RCD-10 (i.e., no load) is 5.0 volts rms. Amplitude is set using the STEP and VERNIER output level controls. The STEP control is an 11 position ladder attenuator which provides coarse attenuation of the output amplitude. The VERNIER control is a divider network which provides a continuously variable amount of attenuation between the coarse steps. For example, setting the STEP attenuator to position 4 sets the output amplitude range from 4/11ths to 5/11ths of full scale. The VERNIER attenuator will then adjust the amplitude over this range, or approximately 1.8 to 2.3 volts rms. Resolution of the VERNIER attenuator setting is approximately 0.1% of setting.

3-25. OUTPUT CONNECTIONS. The output of the RCD-10 can be connected for either a floating or grounded configuration. An inner floating chassis completely isolates the Oscillators electrical circuits from the front panel, exterior covers and AC line ground. In general, when the instrument is being used with a load that has a permanently grounded low input, such as some digital voltmeters, the output should be connected for a "floating" output. Also, in rack-mounted system applications it is desirable to "float" the RCD-10 and provide a single ground connection at some other common point in the system. When driving an instrument that is floating such as battery operated voltmeters the output should be connected for a "grounded" output. A ground strap is provided on the front panel low output terminal (black) for grounding the low side of the output to chassis ground. When a floating output is desired, the shorting link must be removed from the GND terminal. When the rear panel output terminals are being used the front panel shorting strap must be connected for the desired output configuration.

SECTION IV

THEORY OF OPERATION

4-1. INTRODUCTION.

4-2. GENERAL. This section contains a description of the circuits and the principles of operation for the Model RCD-10 Precision RC Oscillator. The description begins with a general discussion of the instrument. A detailed discussion then follows using simplifier block diagrams to show the interconnection of circuits and their relationship to front panel operating controls.

4-3. SCHEMATICS. Schematic diagrams for the Model RCD-10 are located at the rear of this manual. Refer to these schematics throughout the following theory discussion for circuit details and electrical values of the components.

4-4. RCD-10 CIRCUIT DESCRIPTION.

4-5. GENERAL. The Oscillator circuit consists of a Differential amplifier having a highly stable gain. Negative feedback to the Differential Amplifier is supplied through a bridged-T RC frequency determining network and positive feedback is applied through a specially designed amplitude stabilizing lamp. The relative magnitude of these feedback voltages are set so that there is a net excess of positive feedback to provide oscillation at the desired amplitude.

The Differential Amplifier circuit oscillates at a frequency where the transmission characteristics through the bridged-T network are minimum and phase shift is zero. The FREQUENCY IN CYCLES PER SECOND front panel selector switches select the resistor values and the DECADE switch selects the capacitor values of the bridged-T network to set the output frequency. An Impedance Converter stage reduces the relatively high output impedance of the Differential Amplifier to a low output impedance. The output of the Oscillator is directly coupled through the OUTPUT LEVEL attenuator to front and rear panel output terminals. Figure 4-1 shows a simplified block diagram of the Model RCD-10 Oscillator Circuit.

4-6. DIFFERENTIAL AMPLIFIER STAGE. The Differential Amplifier is contained in the dual Field-effect Transistor Q2. Transistor Q7 is

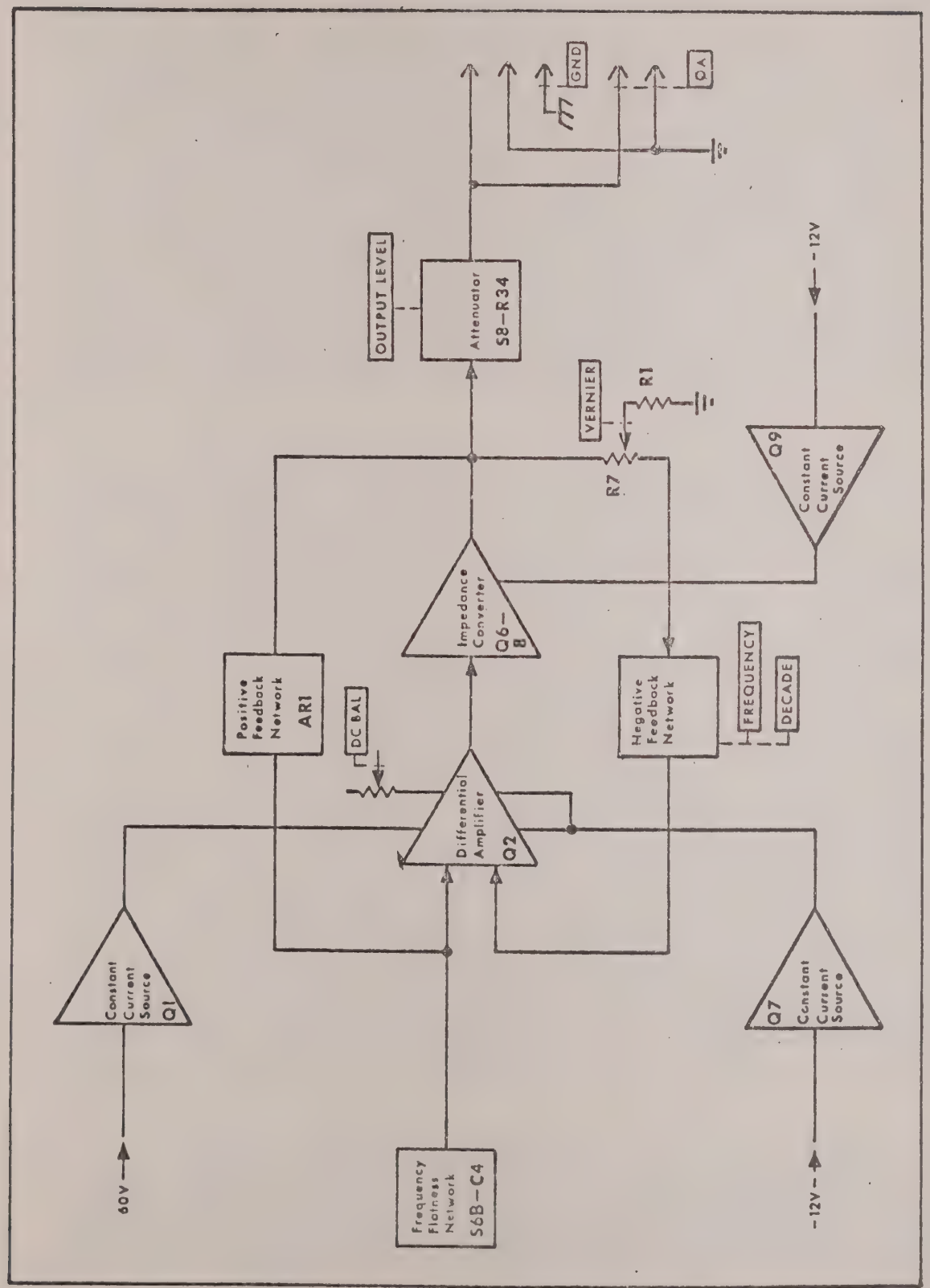

Figure 4-1. Oscillator Basic Block Diagram.

connected to the common sources of Q2 and provides a source of constant current. The emitter of Q7 is connected through emitter resistor R24 to -12 volts. The bian on the base of Q7 is set by the divider network R48-CR2-R49-CR8-R27-R30 connected between -12 volts and +60 volts. Since the base bias voltage is fixed, the current through Q7 will be constant and it's effective to the common sources of Q2 is infinite. The drain of Q2A is connected through resistor R56, transistor Q1 and resistor R5 to the +60 volts supply. The base bias of Q1 is held constant by divider network R48-CR2-R49-CR8-R27-R30 which maintains current through Q1 constant. Thus, R56-Q1-R9 provide an effective infinite drain load impedance for Q2A to provide a large signal gain. The drain of Q2B is connected through Q4 to +60 volts. Connected in this manner the gain of the Differential Amplifier stage will remain extremely constant over a wide range of external parameters. The gate of Q2A is driven by the bridged-t frequency determining network which supplies negative feedback and the gate of Q2B is connected to R25-AR1 which supplies positive feedback. Potentiometer R30 is a DC balance adjustment which sets the DC offset voltage of the Oscillator output to zero.

4-7. IMPEDANCE CONVERTER STAGE. The output of the Differential Amplifier stage is directly coupled from the drain of Q2A to the base of transistor Q6. Transistors Q6-Q8 are connected as a cascaded power amplifier stage to convert the high impedance of the Differential Amplifier stage to a low output impedance. The emitter of Q6 is connected through CR7-C13 to the base of Q8. Zener diode CR7 drops the high DC voltage of about 22 volts present at the drain of Q2A to 0 volt eliminating any DC offset on the Oscillator output signal while maintaining DC coupling between stages. C13 is a bypass capacitor. CR25 provides a source of constant current for CR7. Resistor R22 is the collector load resistor for Q6. TransistorQ9 is a constant current source for Q8. The bias at the base of Q9 is fixed by the divider network R28-CR9-R29. The emitter of Q9 is connected through R32 to the -12 volts power supply. Connected in this manner, Q9 forms the emitter resistance for emitter follower Q8 and since the current is held constant the effective emitter impedance of Q8 is infinite to provide a large signal gain. Diodes CR12-CR13 are connected between the base of Q8 and -6.2 volts which limits the negative voltage swing at the base of Q8 to about -7.2 volts peak. Diodes CR10-CR11 are connected at the same point to limit the positive voltage swing to about +8.7 volts peak. Resistor R31 is a series dropping resistor for zener diode CR11. This limiting circuit prevents the output amplitude of the Oscillator from increasing excessively when changing the frequency setting since their is an inherent thermal time lag in Amplitude Stabilizer AR1. The output signal of the Impedance Converter stage is taken from the emitter of Q8.

4-8. FEEDBACK NETWORKS. When power is initially applied, approximately one-half of the signal at the emitter of Q8 is applied through the Positive Feedback Network AR1-R26 & R25 to the gate of Q2B. Approximately one-third of the same signal is connected through the Negative Feedback Network R7 Buffer Amplifier A2-S1-S2-S3-C1-S6 to the gate of Q2A.

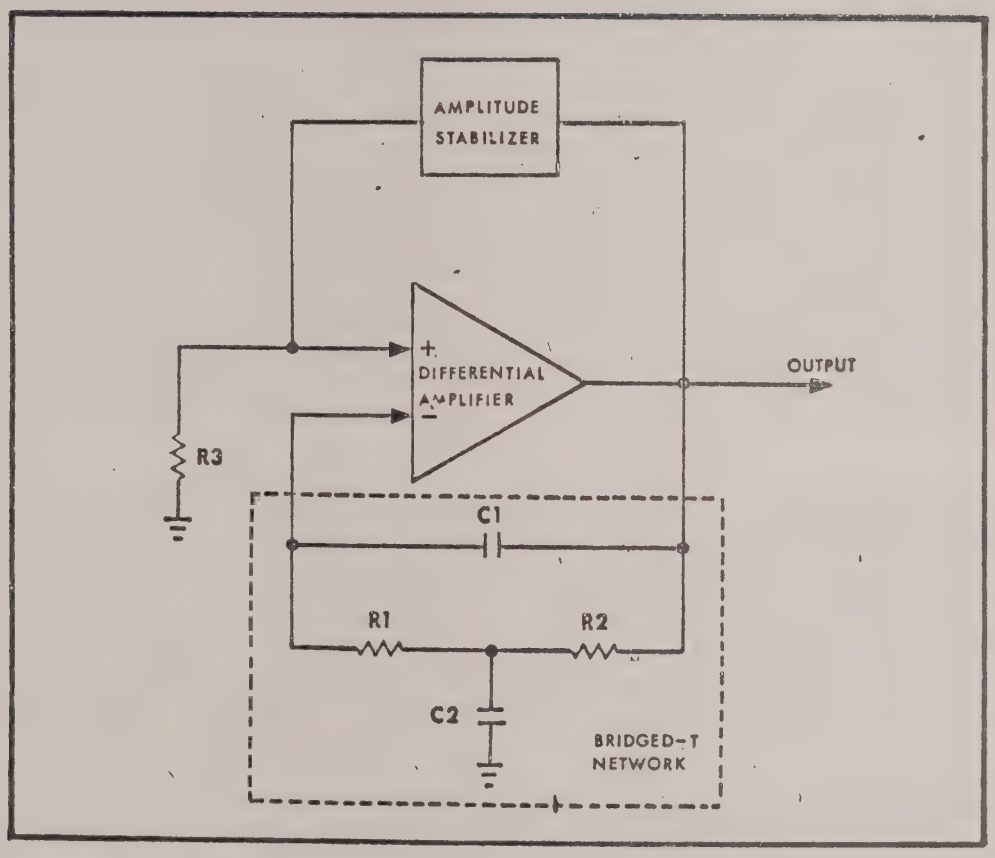

Figure 4-2. Bridged-T Equivalent Circuit.

Since the positive feedback is greater than the negative feedback voltage the Differential Amplifier will oscillate at a frequency which is determined by the bridged-T Negative Feedback Network.

4-9. POSITIVE FEEDBACK NETWORK. The stabilizing element AR1 is a lamp which has a mechanically stable tungsten resistive element enclosed within a vacuum. When power is initially applied, the filament of AR1 heats up increasing it's resistance which reduces the amount of positive feedback. The positive feedback stabilizes at a level that is slightly greater than the amount of negative feedback. Since the output amplitude of the Oscillator is nominally 5 volts rms and the gain of the Differential Amplifier is approximately 30, the excess positive feedback is about 0.166 volts. If the Oscillator's output amplitude increases, the voltage drop across AR1 will increase which raises it's temperature and increases the resistance. The positive feedback is then reduced and the net signal applied to the Differential Amplifier is lowered, stabilizing the output amplitude. If the amplitude decreases, the voltage drop across AR1 will decrease which will lower it's filament temperature and decrease the resistance. The positive feedback is then increased and the net signal applied to the Differential Amplifier is raised which stabilizes the output amplitude. Potentiometers R13-R16-R19 are connected between the positive input of the Differential Amplifier and ground through S6B and adjust the amount of positive feedback for each decade frequency range for proper amplitude tracking and range to range amplitude flatness.

4-10. BRIDGED-T NEGATIVE FEEDBACK NETWORK. The negative feedback for the Differential Amplifier stage is supplied through the bridged-T Negative Feedback Network which determines the frequency of the Oscillator. The feedback through this network is degenerative, however the bridged-T has a sharp null at one frequency which reduces the degenerative feedback and causes oscillation at this frequency. The ratio of capacitors C1-C2 determine the steepness of this transmission slope. Figure 4-2 shows a simplified equivalent circuit for the bridged-T network

1. The DECADE range switch S6A-S6D selects the appropriate value of capacitors C1-C2 of figure 4-2, which determines the four decade frequency ranges. DECADE range switch S6C connects the corresponding front panel decimal indicator lamp DS1-DS2-DS3-DS4 to -12 volts and the frequency setting is always displayed directly in Hertz. Variable capacitors C1E and C2F calibrate the Oscillator frequency on the 10 kilohertz range.

2. The FREQUENCY IN CYCLES PER SECOND switches S1-S2-S3 select the appropriate resistance values of R1-R2 in figure 4-2, which sets the incremental frequency steps of the Oscillator. R1 and R2 of figure 4-2 represent the three digits S1-S2-S3 which are switched resistance decks connected in parallel. The first two significant digits S1-S2 utilize nine resistors in a progressive shorting configuration. The frequency is inversely proportional to resistance and will go up as the selected resistance goes down. For example,

two resistors in parallel will provide half the resistance and therefore twice the frequency of oscillation; three in parallel provides one-third the resistance and three times the frequency, etc. The third digit uses a series ladder arrangement of resistors. This series configuration minimizes any unwanted capacitive reactance at the higher resistance values required. In order for the frequency digits to be related by decades, the resistors in the second digit have a value 10 times those used in the first digit, and etc. Specifically, the first digit has nine 31,600 ohm resistors, the second digit 31,600 ohm resistors. The third digit has appropriate values of resistors in the ladder to maintain a decade relationship. The Differential Amplifier is designed for optimum performance with values of R1 and R2 (figure 4-2) from approximately 3,000 ohms to 30,000 ohms and the best performance is achieved when the most significant digit of the desired frequency is set in the first or left-hand frequency digit.

3. The VERNIER frequency control R7 varies the amplitude of the Differential Amplifier stage output signal which is applied to the low-pass section of the bridged-T network C2-R2 (figure 4-2), while the voltage applied to the high-pass portion C1-R1 is maintained at a constant level. Since the resonant frequency of the bridged-T network is determined by the sum of the transfer functions of the high and low-pass sections in a series manner, the reduction of voltage applied to the low-pass section will increase the frequency of zero phase-shift and cause a corresponding change in the Oscillator frequency. This method of frequency control creates no significant change in transmission through the network. The VERNIER frequency control is a high resolution potentiometer which will accurately set the output frequency between the incremental steps of the least significant digit.

4-11. OUTPUT ATTENUATOR. The nominal 5 volt rms output signal of the Impedance Converter stage is directly connected to the OUTPUT LEVEL controls S8-R34. S8 is an 11 position step attenuator which selects progressive steps of the resistive ladder network R30A through R30L. The VERNIER attenuator R34 is connected across S8 to provide a variable amount of attenuation between the fixed steps. The output impedance of the Oscillator is determined by the impedance of the attenuator which is 200 ohms when set to midrange (position 5) decreasing to 50 ohms at either end of the ladder. The output signal is directly connected from R34 to front panel terminals E1-E2 and rear panel terminals E3-E4.

4-12. OSCILLATOR POWER SUPPLY. The Power Supply provides regulated voltages of -12 volts, +12 volts, +60 volts and -6.2 volts. Lamps DS5-DS6-DS7-DS8-DS9 are directly connected across the secondary of T1 and illuminate the front panel frequency digit windows when AC power is applied.

4-13. POWER INPUT. Power is applied to the primary of T1 through the AC line fuse F1, POWER switch S2 and line voltage selector

switch S1. The line voltage selector switch connects the split primaries of T1 in parallel for 115 volts operation or in series for 230 volts operation.

4-14. -12 VOLTS SUPPLY. The output of the secondary is rectified by rectifiers CR21-CR23. The unregulated voltage is filtered by capacitor C23 and then applied to the -12 volt series regulator Q12. The current through the series regulator is controlled by an error amplifier to provide the correct regulated output voltage.

1. The error amplifier is connected as a comparator. Reference voltage for the comparator is provided by zener diode CR14 which sets the emitter of Q10B at about -6.2 volts. The base level of Q10A is determined by voltage divider R34-R35 between the output of the supply and ground. R37 is the emitter resistor for Q10A and R36 provides a current source for zener diode CR14. Transistor Q15 is connected between the unregulated -12 volts and the collector of Q10B to provide a source of constant collector current for Q10B. Since the current through Q15 is held constant the effective collector load impedance for Q10B is infinite to provide a large signal gain. R36 is a current limiting resistor and C19 is a bypass capacitor. The comparator action of Q10A and Q10B attempts to maintain an equal voltage at the base of Q10A and emitter of Q10B. For example, assume that the output voltage increases (becomes more negative) due to a change in load or an increase in line voltage. The negative going level at the output is applied across voltage divider R34-R35 and the base of Q10A goes negative also. This reduces the current through Q10A and the voltage drop across emitter resistor R37, and the base of Q10B goes negative. This allows Q10B to conduct more and it's collector voltage goes positive, resulting in reduced bias across series regulator Q12. Reduced current through Q12 also means that there is less current through the load and the output voltage decreases (less negative).

2. Short circuit protection transistor Q11 protects the -12 volts supply if the output is shorted. For normal operation the emitter-base bias voltage of Q11 is insufficient to bias it on. However, if excessive current is drawn through the series regulator, this current flows through R33. The voltage drop across R33 will increase until it is sufficient to forward bias Q11. This allows Q11 to conduct drawing collector current from Q10B. This results in results in reduced bias current for Q14-Q12, which reduces the output current.

4-15. +12 VOLTS SUPPLY. Rectifiers CR22-CR24 provide the rectified unregulated voltage for the +12 volts supply. This voltage is filtered by C24 and connected to the +12 volts series regulator Q17. Reference voltage for this supply is provided by zener diode CR15 which is connected from the base of the series regulator to ground. Resistor R39 is returned to the +60 volts supply to provide a current source for CR15. Short circuit protection is provided by Q16 and R42. If the output is shorted, Q16 is biased on to limit the con-

conduction of the series regulator.

4-16. +60 VOLTS SUPPLY. CR18-CR19 provide the rectified voltage for the +60 volts supply. C22 filters the rectified voltage which is connected to the series regulator Q13. Reference voltage for this supply is provided by voltage divider R40-R41 between the regulated -12 volts and the output of the +60 volts supply. Since the -12 volts is regulated any change at the base of the error amplifier Q18 is due to a change at the output of the +60 volts supply. Regulation of the voltage is controlled by error amplifier Q18 in a similar manner to that described for the -12 volts supply. The collector of Q18B is connected to constant current source Q20 to provide a large voltage gain for stable operation. The base bias voltage of Q20 is held constant by divider CR16-CR17-R51. Capacitor C17 is connected between the output of the supply and the error amplifier to improve the response of the regulator circuit to low-frequency changes at the output. Short circuit protection is provided by Q19 and R54 if the output of the supply is shorted, in a similar manner to the -12 volts supply.

4-16. -6.2 VOLTS SUPPLY. -6.2 volts is taken directly from zener diode CR14 to provide the negative clipping voltage for diodes CR12-CR13.

SECTION V

CALIBRATION

5-1. GENERAL.

5-2. Complete calibration instructions for the Model RCD-10 and RCD-10B are given in this section of the manual. The following procedures will calibrate the Oscillator to the performance specifications which are given in table 1-1.

5-3. CALIBRATION FREQUENCY.

5-4. The Model RCD-10 should be checked, and calibrated if necessary, every 90 days of operation to insure proper performance when the Oscillator is being used as a precision AC source.

5-5. TEST EQUIPMENT REQUIRED.

5-6. The test instruments required to complete the calibration procedures are listed below. The specifications given for each instrument are the minimum required to calibrate the RCD-10. Should alternate test instruments be substituted they must meet or exceed these listed specifications.

1. DC VOLTMETER.- Range: 1.0 to 1.5 volts full scale. It must provide a high degree of AC isolation. Example: Universal Avometer Model 8.

2. PRECISION AC VOLTMETER.- Accuracy: better than 0.1%; Resolution: 100 microvolts; Range: 0 to 10 volts rms. Example: Fluke Model 931 AC Differential Voltmeter.

3. DIGITAL RECIPROCAL COUNTER.- Accuracy: 1×10^{-5}; Resolution: 6 digits; Frequency range: 0.1 to 100,000 Hertz; Example: General Radio Type 1159.

4. VARIABLE AUTOTRANSFORMER.- Range: 103 to 127 volts rms; Power: 30VA output. Example: General Radio Type W10MT3W with voltmeter.

5-7. CALIBRATION PROCEDURE.

5-8. GENERAL. The calibration procedure below is arranged in a sequence which allows the Model RCD-10 to be calibrated with the minimum interaction of adjustments. If the Oscillators measured performance is within the limits which are defined in the CHECK step it is recommended that no further adjustments be made. However, if it is desired to obtain the maximum overall performance of the RCD-10 then each adjustment should be made to the exact setting, even though the measurement falls within the specification limits which are stated in the CHECK step.

5-9. TEST SETUP AND WARM UP. The following steps describe the initial setup to be made before proceeding with the calibration procedures.

1. Connect the AC line cord of the Oscillator to the Autotransformer.

2. Connect the Autotransformer to a 115 volt AC power source and set the POWER switch to ON.

3. Set the Oscillator POWER switch to on.

4. Allow the Model RCD-10 to warm up for 1½ hours at 25°C, ±5°C, prior to making any calibration measurements or adjustment.

5-10. RCD-10 CALIBRATION.

5-11. DUST COVER REMOVAL. If any of the following calibration steps determine that internal adjustments are required it will be necessary to remove the dust cover from the Oscillator as follows:

1. Set the POWER switch to OFF and disconnect the AC power cord from the rear panel AC LINE receptacle.

2. Remove the two rear panel pan head screws and slide the instrument chassis out of the cover.

3. Place the Oscillator upside down on a convenient insulated working surface.

4. Reconnect the AC line cord to the Autotransformer.

5. Set the POWER switch to ON and allow the RCD-10 to warm up at least 10 minutes before proceeding with the calibration adjustment.

5-12. DC BALANCE ADJUSTMENT. The Oscillator DC balance adjustment is recessed behind the rear panel and is identified DC BAL.

1. TEST EQUIPMENT.

a. DC Voltmeter.

2. TEST SETUP.

a. Connect the DC Voltmeter between the DC BAL rear panel test points.

b. Set the frequency and DECADE range switches to 1000.0 Hertz.

3. CHECK.

a. The DC Voltmeter should read less than ±10 millivolts.

4. CALIBRATION.

a. If not, adjust R30 DC BAL (rear panel) for a reading of exactly 0 volt on the DC Voltmeter.

6-13. OUTPUT AMPLITUDE CALIBRATION. The following steps calibrate the Oscillators amplitude over the decade frequency ranges with the exception of the 10 kHz range which is calibrated in conjunction with the frequency calibration procedure.

1. TEST EQUIPMENT.

a. Precision AC Voltmeter.

2. TEST SETUP.

a. Connect the Precision AC Voltmeter to the front panel output terminals.

b. Set the frequency and DECADE controls for 100.00 Hertz, with the "1" set in the extreme left-hand digit.

c. Set the STEP and VERNIER attenuators for maximum output (fully clockwise).

3. CHECK 100 HERTZ RANGE.

a. The output amplitude should be between 4.985 and 5.035 volts rms.

4. CALIBRATE 100 HERTZ RANGE.

a. If not, adjust the potentiometer R16 for exactly 5.010 volts rms.

5. CHECK 1KHz RANGE.

a. Set the frequency and DECADE controls for 1000.0 Hertz.

b. The output amplitude should be between 4.985 and 5.035 volts rms.

6. CALIBRATE 1KHz RANGE.

a. If not, adjust potentiometer R19 for exactly 5.010 volts rms.

7. CHECK 10KHz RANGE.

a. Set the frequency and DECADE controls for 10000. Hertz.

b. The output amplitude should be between 4.985 and 5.035 volts rms.

c. If not, it will be necessary to perform the frequency calibration procedure for the 10 kilohertz frequency range.

8. CHECK 90 HERTZ.

a. Set the frequency and DECADE controls for 90.000 Hertz.

b. The output amplitude should be between 4.985 and 5.035 volts rms.

9. CALIBRATE 90 HERTZ.

a. If not, adjust potentiometer R13 for exactly 5.010 volts rms.

5-14. OUTPUT FREQUENCY CALIBRATION. The following steps determine if the RCD-10 is within the output frequency accuracy specifications. For the RCD-10B use the procedures given in paragraph 5-17. If the

instrument meets the CHECK step given below it will not be necessary to perform the calibration adjustments given in paragraphs 5-15 and 5-16.

NOTE

The frequency calibration procedures given in paragraphs 5-14 to 5-16 are for the 3 digit RCD-10. For the RCD-10B with 4 digits use the calibration procedures starting with paragraph 5-17.

1. TEST EQUIPMENT.

a. Digital Reciprocal Counter.

NOTE

If a Digital Frequency Counter is used in place of the Reciprocal Counter it must be used in the PERIOD mode for frequencies of less than 1 kilohertz to obtain better than 1.0% resolution without using time base settings longer than 10 seconds.

2. TEST SETUP.

a. Connect the Digital Reciprocal Counter to the Oscillator rear panel DC BAL test points.

3. CHECK.

a. Set the front panel frequency selector switches and the DECADE switch to the settings given in table 5-1.

b. Record the output frequency reading for each setting with the VERNIER control set to the CAL position.

TABLE 5-1. RCD-10 FREQUENCY TRACKING SETTINGS.

FREQUENCY SETTING	1.0% MEASUREMENT RANGE (HERTZ)	RECORDED READING
10.000	9.900 to 10.100	
100.00	99.00 to 101.00	
1000.0	990.0 to 1010.0	
10000.	9900 to 10100	

c. The decade frequency readings should be within ±1.0% of the front panel settings.

d. If each of the readings are within ±1.0% of the decade settings but are ALL higher or lower than the nominal frequency settings it will be necessary to calibrate the VERNIER frequency control setting as described in paragraph 5-15.

e. If the 10 kilohertz frequency reading exceeds the nominal frequency setting by more than ±1.0% it will be necessary to perform the frequency calibration procedure given in paragraph 5-16.

5-15. VERNIER FREQUENCY CONTROL CALIBRATION. If the measurements performed in paragraph 5-14 determine that ALL of the frequency settings exceeded the specification (±1.0%) it will be necessary to calibrate the VERNIER frequency control as follows.

1. TEST EQUIPMENT.

a. Digital Reciprocal Counter.

2. TEST SETUP.

a. Connect the Digital Reciprocal Counter to the rear panel DC BAL test points.

3. CALIBRATION.

a. Set the VERNIER control to the position where ALL of the frequency readings (refer to table 5-1) are within ±1.0% of the nominal settings.

NOTE

If the VERNIER frequency control cannot be set so that all decade ranges are within ±1.0% of the front panel setting, set the VERNIER control so that the lower three decade ranges are within ±1.0% and proceed with the frequency calibration procedure given in paragraph 5-16.

b. Loosen the two set screws on the VERNIER frequency control knob taking care not to rotate or move the shaft from the optimized setting.

c. When the set screws are loose, rotate the knob until the index mark lines up with the CAL index line on the front panel.

d. Tighten the set screws.

e. Recheck the four frequency settings to verify that the VERNIER control knob was not moved during the calibration adjustment and that the readings are still within ±1.0% of the nominal settings with the VERNIER control set to the CAL position.

5-16. FREQUENCY CALIBRATION. The following steps calibrate the output frequency on the 100 kilohertz range. On the RCD-10 (3 digits) calibration adjustments are not provided for the lower decade ranges. If the lower ranges do not meet the frequency specification after calibrating the 100 kilohertz range and optimizing the VERNIER control CAL setting it will be necessary to select timing capacitors for the affected range (C1-C2) or return the Oscillator to Optimation for calibration.

1. TEST EQUIPMENT.

a. Digital Reciprocal Counter.

b. Precision AC Voltmeter.

2. TEST SETUP.

a. Connect the Digital Reciprocal Counter to the rear panel DC BAL test points.

b. Connect the Precision AC Voltmeter to the front panel output terminals.

c. Set the STEP and VERNIER attenuators for maximum output.

d. Set the frequency and DECADE switches for 10000. Hertz with the "1" set in the extreme left-hand digit.

e. Set the VERNIER control to the CAL position.

3. CHECK 10kHz.

a. The output frequency reading should be between 9900 and 10,100 Hertz.

b. The output amplitude should be between 4.985 and 5.035 volts rms.

4. CALIBRATION.

a. If not, adjust C2F until the output frequency reading is exactly 10,000 Hertz.

b. Recheck the output amplitude. It should be between 4.985 and 5.035 volts rms.

c. If not, adjust C1E to exactly 5.01 volts rms.

d. Repeat steps a, b and c until the most optimum settings for both C2F and C1E are obtained for output frequency and amplitude.

NOTE

Variable capacitor adjustments C2F and C1E are interacting as the output frequency is determined by the ratio of the two capacitor settings.

8. CHECK 90kHz SETTING.

a. Set the frequency selector switches to 90000. Hertz.

b. The output frequency reading should be between 89,100 and 90,900 Hertz.

9. CALIBRATION.

a. If not, adjust C4 to exactly 90,000 Hertz.

10. Disconnect the Digital Reciprocal Counter and Precision AC Voltmeter.

5-17. RCD-10B FREQUENCY CALIBRATION. The following steps determine if the RCD-10B (4 digits) is within the output frequency accuracy specification. If the instrument meets the CHECK step given below it will NOT be necessary to perform the calibration adjustments given in paragraphs 5-18 and 5-19.

1. TEST EQUIPMENT.

a. Digital Reciprocal Counter.

NOTE

If a Digital Frequency Counter is used in place of the Reciprocal Counter it must be used in the PERIOD mode for frequencies of less than 1 kilohertz to obtain better than 0.1% resolution without using time base settings longer than 10 seconds.

2. TEST SETUP.

a. Connect the Digital Reciprocal Counter to the rear panel DC BAL test points.

3. CHECK.

a. Set the VERNIER control to the CAL position.

b. Set the frequency selector and DECADE switches to the settings given in table 5-2.

c. Record the output frequency reading for each setting.

TABLE 5-2. RCD-10B FREQUENCY TRACKING SETTINGS.

FREQUENCY SETTING	0.1% MEASUREMENT RANGE (HERTZ)	RECORDED READING
10.000	9.9900 to 10.010	
100.00	99.900 to 100.10	
1000.0	999.00 to 1001.0	
10000.	9990.0 to 10010.	

d. The decade frequency readings should be within ±0.1% of the front panel settings.

e. If each of the frequency readings are within ±0.1% of the decade settings but are ALL higher or lower than the nominal frequency settings it will be necessary to calibrate the VERNIER control setting as described in paragraph 5-18.

f. If one or more but not all of the frequency readings exceed the nominal settings by more than ±0.1% perform the frequency calibration procedure given in paragraph 5-19.

5-18. VERNIER FREQUENCY CONTROL CALIBRATION (RCD-10B). If the measurements performed in paragraph 5-17 determine that ALL of the frequency settings exceeded the specification (±0.1%) it will be necessary to calibrate the VERNIER control as follows.

1. TEST EQUIPMENT.

a. Digital Reciprocal Counter.

2. TEST SETUP.

a. Connect the Digital Reciprocal Counter to the rear panel DC BAL test points.

3. CALIBRATION.

a. Set the VERNIER control to the position where ALL of the frequency readings (refer to table 5-2) are within ±0.1% of the nominal settings.

NOTE

If the VERNIER frequency control cannot be set so that all of the DECADE ranges are within ±0.1% of the front panel settings, set the VERNIER control for exactly 1,000 Hertz on the 1kHz range and proceed with the frequency calibration procedure given in paragraph 5-19.

b. Loosen the two set screws on the VERNIER frequency control knob taking care not to rotate or move the shaft from the optimized setting of step a.

c. When the set screws are loose, rotate the knob until the index mark lines up with the CAL index line on the front panel.

d. Tighten the set screws.

e. Recheck the frequency settings to verify that the VERNIER knob was not moved during the calibration adjustment and the readings are still within ±0.1% of the nominal frequency settings with the VERNIER control set to the CAL position.

5-19. FREQUENCY CALIBRATION (RCD-10B). The following steps calibrate the output frequency of the Oscillator for the four decade frequency ranges.

1. TEST EQUIPMENT.

a. Digital Reciprocal Counter.

b. Precision AC Voltmeter.

2. TEST SETUP.

a. Connect the Digital Reciprocal Counter to the rear panel DC BAL test points.

b. Connect the Precision AC Voltmeter to the front panel output terminals.

c. Set the STEP and VERNIER attenuators to maximum (fully clockwise).

d. Set the VERNIER frequency control to the CAL position.

3. CHECK 10Hz.

a. Set the frequency and DECADE range switches to 10.000 Hertz, with the "1" set in the extreme left-hand digit and the DECADE switch set to the fully counterclockwise position.

b. The output frequency reading should be between 9.990 and 10.010 Hertz.

4. CALIBRATION.

a. If not, adjust R54 until the frequency reading is exactly 10.000 Hertz.

5. CHECK 100Hz.

a. Set the DECADE range switch for 100.00 Hertz.

b. The output frequency reading should be between 99.90 and 100.10 Hertz.

6. CALIBRATION.

a. If not, adjust R55 until the frequency reading is exactly 100.00 Hertz.

7. CHECK 1kHz.

a. Set the DECADE range switch for 1000.0 Hertz.

b. The output frequency reading should be between 999.0 and 1001.0 Hertz.

8. CALIBRATION.

a. If not, adjust R56 until the frequency reading is exactly 1000.0 Hertz.

9. CHECK 10kHz.

a. Set the frequency and DECADE range switches for 10000. Hertz.

b. The output frequency reading should be between 9,990 and 10,010 Hertz.

10. CALIBRATION.

a. If not, adjust C2F until the output frequency reading is exactly 10,000 Hertz.

b. Check the output amplitude on the Precision AC Voltmeter. It should be between 4.985 and 5.035 volts rms.

c. If not, adjust C1E to exactly 5.010 volts rms.

d. Repeat steps a, b, and c until the most optimum settings for both C2F and C1E are obtained for output frequency and amplitude accuracy.

NOTE

Variable capacitor adjustments C2F and C1E are interacting as the output frequency is determined by the ratio of the two capacitor settings.

11. CHECK 90kHz SETTING.

a. Set the frequency selector switches to 90000. Hertz.

b. The output frequency reading should be between 89,910 and 90,090 Hertz.

12. CALIBRATION.

a. If not, adjust C4 to exactly 90,000 Hertz.

13. CHECK 10kHz RANGE TRACKING.

a. Repeat step 9. If the frequency reading at 10,000 Hertz exceeds ±0.1% it will be necessary to recalibrate C2F, C1E and C4 until the amplitude and frequency at 10,000 Hertz and frequency at 90,000 Hertz are within specification.

5-20. The above calibration steps complete the calibration of the Model RCD-10 and RCD-10B.

SECTION VI

ELECTRICAL PARTS LISTING

6-1. INTRODUCTION.

6-2. This section of the manual contains a complete breakdown and description of the replaceable parts.

6-3. SELECTED COMPONENTS.

6-4. Electrical parts which are denoted with an asterisk (*) next to the reference designator are selected and matched for their tolerance values by Optimation. When ordering these parts, it is necessary to include both the model number and serial number of the instrument which the part is to be installed. These parts are NOT interchangeable between Oscillators.

6-5. PARTS ORDERING INFORMATION.

6-6. Replacement parts are available from your local Optimation, Inc. representative or can be obtained from the factory direct. When ordering parts, include the following information:

1. Instrument model number and serial number.
2. Optimation part number of replacement component.
3. Reference designator number.

TABLE 6-1. ELECTRICAL PARTS LISTING

REF DESIG	OPTIMATION PART NO.*	DESCRIPTION
	901243	1st DIGIT SWITCH ASSEMBLY with all components mounted, ready for installation.
R1A*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R1B*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R1C*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R1D*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R1E*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R1F*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R1G*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R1H*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R1I*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R2A*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R2B*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R2C*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R2D*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R2E*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R2F*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R2G*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R2H*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
R2I*	502851	Resistor, Fix MF: 31.6K, 1%, 1/8W
S1	006075	Switch, Rotary: DP 10 position
	901255	2nd DIGIT SWITCH ASSEMBLY with all components mounted, ready for installation.
R3A*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R3B*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R3C*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R3D*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R3E*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R3F*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R3G*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R3H*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R3I*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R4A*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R4B*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R4C*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R4D*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R4E*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R4F*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R4G*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R4H*	502645	Resistor, Fix MF: 316K, 1%, 1/8W
R4I*	502645	Resistor, Fix MF: 316K, 1%, 1/8W

TABLE 6-1. ELECTRICAL PARTS LISTING

REF DESIG	OPTIMATION PART NO.*	DESCRIPTION
S2	006075	Switch, Rotary: DP 10 position
	901260	3rd DIGIT SWITCH ASSEMBLY with all components mounted, ready for installation.
R5A	500380	Resistor, Fix CC: 1.6M, 5%, 1/2W
R5B	502680	Resistor, Fix MF: 523K, 1%, 1/8W
R5C	502600	Resistor, Fix MF: 261K, 1%, 1/8W
R5D	502570	Resistor, Fix MF: 158K, 1%, 1/8W
R5E	502550	Resistor, Fix MF: 102K, 1%, 1/8W
R5F	502510	Resistor, Fix MF: 75K, 1%, 1/8W
R5G	502490	Resistor, Fix FM: 56,2K, 1%, 1/8W
R5H	502450	Resistor, Fix FM: 44.2K, 1%, 1/8W
R5I	502650	Resistor, Fix MF: 348K, 1%, 1/8W
R6A	500380	Resistor, Fix CC: 1.6M, 5%, 1/2W
R6B	502680	Resistor, Fix MF: 523K, 1%, 1/8W
R6C	502600	Resistor, Fix MF: 261K, 1%, 1/8W
R6D	502570	Resistor, Fix MF: 158K, 1%, 1/8W
R6E	502550	Resistor, Fix MF: 102K, 1%, 1/8W
R6F	502510	Resistor, Fix MF: 75K, 1%, 1/8W
R6G	502490	Resistor, Fix MF: 56.2K, 1%, 1/8W
R6H	502450	Resistor, Fix MF: 44.2K, 1%, 1/8W
R6I	502650	Resistor, Fix MF: 348K, 1%, 1/8W
S3	006075	Switch, Rotary: DP 10 position
	901288	RANGE SWITCH ASSEMBLY with all components mounted, ready for installation.
C1A*	523061	Capacitor, Fix POS: 0.25 mfd, 1%, 50V
C1B*	523041	Capacitor, Fix POS: 0.025 mfd, 1%, 50V
C1C*	520301	Capacitor, Fix Mica: 2500 pF, 1%, 500V
C1D	520120	Capacitor, Fix Mica: 240 pF, 1%, 500V
C1E	532020	Capacitor, Var Cer: 3-12 pF, 350V
C2C*	520501	Capacitor, Fix Mica: 0.01 mfd, 1%, 500V
C2D*	520230	Capacitor, Fix Mica: 910 pF. 1%, 500V
C2E	520059	Capacitor, Fix Mica: 56 pF, 1%, 500V
C2F	532040	Capacitor, Var Cer: 4.5-25 pF, 350V
R7	510115	Resistor, Var CC: 100, 20%, 2W
R76		Resistor, Fix: Factory selected value
S6	006120	Switch, Rotary: 6P, 5 position

TABLE 6-1. ELECTRICAL PARTS LISTING.

REF DESIGN	OPTIMATION PART NO.*	DESCRIPTION
	901276	11 POSITION ATTENUATOR ASSEMBLY with all components mounted, ready for installation.
R30A	502019	Resistor, Fix MF: 49.9, 1%, 1/8W
R30B	502019	Resistor, Fix MF: 49.9, 1%, 1/8W
R30C	502019	Resistor, Fix MF: 49.9, 1%, 1/8W
R30D	502019	Resistor, Fix MF: 49.9, 1%, 1/8W
R30E	502019	Resistor, Fix MF: 49.9, 1%, 1/8W
R30F	502019	Resistor, Fix MF: 49.9, 1%, 1/8W
R30G	502019	Resistor, Fix MF: 49.9, 1%, 1/8W
R30H	502019	Resistor, Fix MF: 49.9, 1%, 1/8W
R30I	502019	Resistor, Fix MF: 49.9, 1%, 1/8W
R30J	502019	Resistor, Fix MF: 49.9, 1%, 1/8W
R30K	502019	Resistor, Fix MF: 49.9, 1%, 1/8W
R30L	502019	Resistor, Fix MF: 49.9, 1%, 1/8W
R34	510114	Resistor, VAR: 100
S8	006080	Switch, Rotary: 11 position

TABLE 6-1. ELECTRICAL PARTS LISTING

REF DESIGN	OPTIMATION PART NO.	DESCRIPTION
		RCD-10 CHASSIS ASSEMBLY
AR1	901181	Amplitude Stability Assembly
DS1	551115	Lamp, Incandescent: 12V miniature
DS2	551115	Lamp, Incandescent: 12V miniature
DS3	551115	Lamp, Incandescent: 12V miniature
DS4	551115	Lamp, Incandescent: 12V miniature
DS5	551115	Lamp, Incandescent: 12V miniature
DS6	551115	Lamp, Incandescent: 12V miniature
DS7	551115	Lamp, Incandescent: 12V miniature
DS8	551115	Lamp, Incandescent: 12V miniature
DS9	551115	Lamp, Incandescent: 12V miniature
F1	570120	Fuse: 0.3A, 125V Slo-Blo (115V operation)
F1A		Fuse: 0.15A, 250V Slo-Blo (230V operation)
Q1-Q11		Not Used
Q12	540260	Transistor: 2N4918
Q13	540262	Transistor: 2N4923
Q14-Q16		Not Used
Q17	540261	Transistor: 2N4921
R1-R29		Not Used
R30	511084	Resistor, Var WW: 250 Ohm, 10%, 2W
R31		Not Used
R32	502019	Resistor, Fix MF: 49.9, 1%, 1/8W
S1	006055	Switch, Slide: DPDT
S2	006005	Switch, Toggle: SPDT
T1	560111	Transformer, Power

TABLE 6-1. ELECTRICAL PARTS LISTING

REF DESIG	OPTIMATION PART NO.	DESCRIPTION
A1	901157	Main Oscillator Printed Circuit Board Assembly
C1	524022	Capacitor, Fix Tant: 10mfd, 35V
C2	522140	Capacitor, Fix Cer: .001mfd
C3	524022	Capacitor, Fix Tant: 10mfd, 35V
C4	531020	Capacitor, Var Air: 2.2-25pf
C5	522200	Capacitor, Fix Cer: .1mfd, 100V
C6	522200	Capacitor, Fix Cer: .1mfd, 100V
C7		Not Used
C8		Not Used
C9	522140	Capacitor, Fix Cer: .001 mfd,
C10	522200	Capacitor, Fix Cer: .1mfd, 100V
C11		Not Used
C12	525020	Capacitor, Fix Elec: 6mfd, 100V
C13	524022	Capacitor, Fix Tant: 10mfd, 35V
C14	522200	Capacitor, Fix Cer: .1mfd, 100V
C15	522140	Capacitor, Fix Cer: .001mfd,
C16	524022	Capacitor, Fix Tant: 10mfd, 35V
C17	525020	Capacitor, Fix Elect: 6mfd, 100V
C18	524022	Capacitor, Fix Tant: 10mfd, 35V
C19	522148	Capacitor, Fix Cer: .01mfd
C20	522200	Capacitor, Fix Cer: .1mfd, 100V
C21	524022	Capacitor, Fix Tant: 10mfd, 35V
C22	525056	Capacitor, Fix Elect: 20mfd, 150V
C23	525255	Capacitor, Fix Elect: 500mfd, 25V
C24	525255	Capacitor, Fix Elect: 500mfd, 25V
C25	522200	Capacitor, Fix Cer: .1mfd, 100V
C26	522200	Capacitor, Fix Cer: .1mfd, 100V
C27		Not Used
C28	522050	Capacitor, Fix Cer: 22pf
CR1		Not Used
CR2	543020	Diode, Silicon, Signal: 1N456A
CR3		Not Used
CR4	544054	Diode, Zener: 22V, 5%
CR5	543200	Diode, Silicon, Signal: 1N3064
CR6	543200	Diode, Silicon, Signal: 1N3064
CR7	544054	Diode, Zener: 22V, 5%
CR8	543020	Diode, Silicon, Signal: 1N456A
CR9	543020	Diode, Silicon, Signal: 1N456A
CR10	543200	Diode, Silicon, Signal: 1N3064
CR11	544031	Diode, Zener: 8.2V
CR12	543200	Diode, Silicon, Signal: 1N3064
CR13	543200	Diode, Silicon, Signal: 1N3064
CR14	544017	Diode, Zener,: 6.2V, 5%
CR15	544096	Diode, Zener: 13V, 5%
CR16	543020	Diode, Silicon, Signal: 1N456A
CR17	543020	Diode, Silicon, Signal: 1N456A
CR18	543928	Diode, Silicon, Rectifier: 1N4005
CR19	543928	Diode, Silicon, Rectifier: 1N4005
CR20	543020	Diode, Silicon, Signal: 1N456A
CR21 thru CR24	543928	Diode, Silicon, Rectifier: 1N4005

TABLE 6-1. ELECTRICAL PARTS LISTING

REF DESIG	OPTIMATION PART NO.	DESCRIPTION
CR25	544333	Regulator, Current: 2.2ma
DS1	551110	Lamp, Incandescent: 6.3V
Q1	540275	Transistor: 2N5087
Q2	540392	Transistor: Dual FET; NDF 9410 or FD-1508 or 2N5454
Q3		Not Used
Q4	540082	Transistor: 2N3053-2
Q5	540200	Transistor: 2N4250
Q6	540280	Transistor: 2N5249
Q7	540170	Transistor: 2N3707
Q8	540120	Transistor: 2N3512
Q9	540082	Transistor: 2N3053-2
Q10	540317	Transistor: TD601
Q11	540192	Transistor: 2N4036-2
Q12		Not Used
Q13		Not Used
Q14	540200	Transistor: 2N4250
Q15	540319	Transistor: TD2219
Q16	540082	Transistor: 2N3053-2
Q17		Not Used
Q18	540318	Transistor: TD602
Q19	540082	Transistor: 2N3053-2
Q20	540275	Transistor: 2N5087
R1	502160	Resistor, Fix MF: 1.15K Ohm, 1%, ½W
R2 thru R4		Not Used
R5	502269	Resistor, Fix MF: 6.04K Ohm, 1%, 1/8W
R6	502324	Resistor, Fix MF: 13.7K Ohm, 1%, 1/4W
R7	500120	Resistor, Fix CC: 1K Ohm, 10%, 1/2W
R8		Not Used
R9		Not Used
R10	500284	Resistor, Fix CC: 120K Ohm, 5%, ½W
R11	507197	Resistor, Fix WW: 290 Ohm, 1%, ½W
R12	502259	Resistor, Fix MF: 5.11K Ohm 1%, 1/4W
R13	511220	Resistor, Var WW: 10K Ohm
R14	507162	Resistor, Fix WW: 200 Ohm, 1%, ½W
R15	502259	Resistor, Fix MF: 5.11K Ohm, 1%, ¼W
R16	511220	Resistor, Var WW: 10K Ohm
R17	507162	Resistor, Fix WW: 200 Ohm, 1%, ½W
R18	502259	Resistor, Fix MF: 5.11K Ohm, 1%, ¼W
R19	511220	Resistor, Var WW: 10K Ohm
R20	500450	Resistor, Fix CC: 16M Ohm, 5%, ¼W
R21		Not Used
R22	500173	Resistor, Fix CC: 5.1K Ohm, 5%, ¼W
R23		Not Used
R24	502221	Resistor, Fix MF: 3.01K Ohm, 1%, 1/8W
R25	507194	Resistor, Fix WW: 250 Ohm, 1%, ½W
R26		Not Used
R27	502194	Resistor, Fix MF: 1.91K Ohm, 1%, ¼W
R28	502208	Resistor, Fix MF: 2.32K Ohm, 1%, ¼W
R29	502101	Resistor, Fix MF: 499 Ohm, 1%, 1/8W
R30	500030	Resistor, Fix CC: 10 Ohm, 10%, 1/4W

TABLE 6-1. ELECTRICAL PARTS LISTING

REF DESIG	OPTIMATION PART NO.	DESCRIPTION
R31	500120	Resistor, Fix CC: 1K Ohm, 10%, ½W
R32	502019	Resistor, Fix MF: 49.9 Ohm, 1%, 1/8W
R33	500004	Resistor, Fix CC: 1.5 Ohm, 5%, ½W
R34	502257	Resistor, Fix MF: 4.99K Ohm, 1%, ½W
R35	502260	Resistor, Fix MF: 5.36K Ohm, 1%, ½W
R36	502129	Resistor, Fix MF: 909 Ohm, 1%, 1/8W
R37	500230	Resistor, Fix CC: 18K Ohm, 5%, ½W
R38	500140	Resistor, Fix CC: 2K Ohm, 5%, ½W
R39	500215	Resistor, Fix CC: 12K Ohm, 10%, ½W
R40	502501	Resistor, Fix MF: 60.4K Ohm, 1%, ¼W
R41	502321	Resistor, Fix MF: 12.1K Ohm, 1%, ¼W
R42	500005	Resistor, Fix CC: 2.7 Ohm, 5%, ½W
R43	500330	Resistor, Fix CC: 470K Ohm, 10%, ½W
R44	502120	Resistor, Fix MF: 665 Ohm, 1%, 1/8W
R45	500230	Resistor, Fix CC: 18K Ohm, 5%, ½W
R46	500220	Resistor, Fix CC: 15K Ohm, 5%, ½W
R47		Not Used
R48	502191	Resistor, Fix MF: 2K Ohm, 1%, 1/8W
R49	502338	Resistor, Fix MF: 16.5K Ohm, 1%, ½W
R50	502530	Resistor, Fix MF: 90.9K Ohm, 1%, ½W
R51	500230	Resistor, Fix CC: 18K Ohm, 5%, ½W
R52	502120	Resistor, Fix MF: 665 Ohm, 1%, 1/8W
R53	502647	Resistor, Fix MF: 330K Ohm, 1%, 1/8W
R54	500031	Resistor, Fix CC: 10 Ohm, 5%, ½W
R55		Not Used
R56	500155	Resistor, Fix CC: 3.9K Ohm, 5%, ¼W
R57 thru R59		Not Used
R60	500030	Resistor, Fix CC: 10 Ohm, 10%, ¼W
A2	901146	Frequency Vernier Buffer Amplifier Printed Circuit Board Assy
AR1	547026	Op. Amplifier: LM318H
C1	522025	Capacitor, Fix Cer: 6.8pf, 1KV
C2	522200	Capacitor, Fix Cer: .1uf, 100V
C3	522200	Capacitor, Fix Cer: .1uf, 100V
R1	500210	Resistor, Fix CC: 10K, 10%, ½W
R2	500210	Resistor, Fix CC: 10K, 10%, ½W

REVISIONS			
SYM	DESCRIPTION	BY	DATE
A	ADD VOLTAGES FM SN 2999	RAK	18 JAN 82

OUTPUT
FRONT PANEL / REAR PANEL
E1 E3 E2 E4 E5

R32 499 — BROWN — RED — BLACK — GREEN
R34 100 — FREQ STEP AMPLITUDE
R30A THRU R30L 499

+60 +12 -12

R1 145K 40

+60

C1 10/35V — CR2 1N456A — R48 2K — R5 604K — C10 .1 — R22 5.1K 5% — C11 3.3PF

Q1 2N5087 — R56 3.3K — Q6 2N5249 — CR7 22V — R49 16.5K

C12 6/100V — IN3064(3) CR12 CR13 — C13 10/35V — R31 1K — CR10 — CR11 8.2V ±5%

Q8 2N3512 — CR25 CL2220 — R60 10 — DS1 #12

Q4 2N3053-2 — CR4 22V — R6 13.7K — C3 10/35V — Q5 2N4250 — R24 3.01K — C26 .1

CR8 1N456A — R27 131K ±1% — R28 226K — CR9 1N456A — Q9 2N3053-2 — R32 499 — R30 10 — C9 .001

R33 15 5% — Q11 2N4036-2 — Q14 2N4250 — Q15 TD2219 — CR20 1N456A — R35 909K

R34 499K — C28 * 22PF — R36 909 — C18 10/35V — CR14 1N821 — R39 12K 5% — C21 10V — CR15 13V

Q12 2N 4918 — Q13 2N 4923 — CR6 CR17 1N4004A (2) — Q20 2N5087 — R51 18K 5% — R52 68 — R53 * 230K — CR18 1N4005 (2) — CR19 — C22 20/150V — Q18 TD602

R19 2N 4033 — R43 470K — R40 6.34K — C19 6/100V — R41 12.1K

CR21-24 1N4005 (4) — C23 500 25V — C24 500 25V — R38 909K

C16 10/35V — Q16 2N3053 — R42 2.7 5% — Q17 2N4921 — FRONT — 2N-1918 2N4921 — R30 250 — DC BAL TEST POINT — COUNTER MONITER OPT 'J'

T1 PN 560111 — WHT/BRN BU WHT/VIO — BRN RED ORN YEL — S1 — 210-250 F1-1.6A — 105-125 F1-3A — S2 — F1 — J1 — AC LINE 50-400 Hz

DS5-DS9 #19(5) GRY — WHT/ORN GRY — BLK — WHT/ORN GRY

R1A THRU R1 † 316K — R2A THRU R2 † 316K — S1A — S1B
R3A THRU R3 † 316K — R4A THRU R4 † 316K — S2A — S2B
R5A THRU R5 † — R6A THRU R6 †
1.6M 5% — 523K — 102K — 78K — 56.2K — 44.2K — 348K

C1A † .25 — C1B † .025 — C1C † .0025 — C1D .0034 — C1E 3-12PF — 560 — WHITE

S1C — S2C — S3C — S4C — DS1 — DS2 — DS3 — DS4 — #19(4)

S6B — S6A — BRN/WHT — RED — BRN/WHT — ORN/WHT — R7C 5 TC — C1 † — C2 † — C3 † — C4 † — 47-250PF

AR1 — 10KHZ

R26 0-20 — C4 22-34 — R11 290 W W — R12 5.11K — R13 10K — R25 250 W W — R14 200 W W — R15 5.11K — R16 10K — R17 200 W W — R18 5.11K — R19 10K — R21 0-20 — † C7 1MF — † C8 1 — IN 3064 (2) CR6 — CR5 — R20 16M, 5% — C5 .1 (2) — C6

R10 120K 5% — SYNC INPUT

A1
DET: 105017
SILK: 105243
ASS'Y: 901157

CALIBRATION CONTROLS

FREQUENCY	10KHZ	C1E,C2F
AMPLITUDE	10-99.9HZ	R13
	100-999HZ	R16
	1KHZ-9.99KHZ	R19
	10KHZ-99.9KHZ	R19, C1E, C2F

LEGEND S6
POS. 1: 1-99.9HZ
2: 100-999HZ
3: 1KHZ-9.99KHZ
4: 10KHZ-99.9KHZ

7. ⏚ DENOTES COMMON ELECTRICAL GND ON INNER FLOATING CHASSIS
6. ⏚ DENOTES OUTER CHASSIS AND PANEL GROUND
5. † SELECTED TOLERANCE
4. * FACTORY SELECTED VALUE
3. # OPTIONAL PART
2. ALL RESISTORS ±1%
1. ALL VALUES OF RESISTANCE IN OHMS, CAPACITANCE IN MFD
NOTES: UNLESS OTHERWISE SPECIFIED

DASH NO.	QTY	DESCRIPTION	PART OR IDENTIFYING NO.	VENDOR	MFG. / NO.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ±1/32 — DECIMALS XX ± .010 XXX ± .005 — ANGLES ±1°

DRAWN	[illegible]	1-9-77
CHECKED	[illegible]	1-6-77
PROJECT ENGINEER		
APPROVED		
APPROVED		
CUSTOMER		
MATL. FROM DRAWING NO.		
MATERIAL		
TREATMENT		
FINISH		
FIN. WT.		
NEXT ASSY		

OPTIMATION,

DRAWING NAME: SCHEMATIC DIAGRAM SOLID STATE OSC

MODEL: ROD 10 — DWG. SIZE: D — DRAWING NO.: 2420 — REV.: A

SPEC. CONTROL NO. — SCALE — SHEET 1 OF 1

WARRANTY

JULIE RESEARCH LABORATORIES, INC. guarantees to the original purchaser that all instruments shall be free from defects in material and workmanship for a period of one (1) year after date of initial shipment. Our liability is limited to repairing and replacing any defective part with the exception of vacuum tubes, panel lamps, fuses, choppers, and batteries. The warranty lapses, if upon our investigation, we judge that the instrument has been abused in any way.

WARRANTY RESTRICTIONS

If the instrument or any portion thereof has been abused, misused, damaged by accident or negligence, or if any serial number or seal has been removed or altered, the warranty is void.
All claims for instruments found to be defective on receipt must be filed in writing 30 days from date of invoice.

SHIPPING INSTRUCTIONS

If equipment is in warranty, equipment must be returned to JRL transportation pre-paid in order to maintain the validity of the warranty. All shipping and related charges for any equipment returns, in warranty or otherwise, shall be paid by the customer.

Each individual unit, whether alone or part of a system, is to be packed separately with sufficient padding to insure safe transportation. Failure to comply will render the warranty null and void and the shipment will not be accepted.

NO RETURNS SHALL BE ACCEPTED BY JRL WITHOUT A RETURN AUTHORIZATION NUMBER

Please call customer service (212) 245-2727 for a return authorization number. JRL is not obligated to accept any equipment, regardless of warranty status, unless such equipment has been assigned a return authorization number.